

1 Improved Nozzle

2

3 The present invention relates to a nozzle. In particular,  
4 but not exclusively, the present invention relates to a  
5 nozzle for use with a pressurised water source as  
6 typically used in the offshore environment.

7

8 During well completion, a surface well test package is  
9 used to evaluate well reservoir parameters and  
10 hydrocarbon properties. The evaluation of hydrocarbon  
11 properties requires the flow of a hydrocarbon fluid to  
12 the well test package from the well. Once the test has  
13 been made it is necessary to dispose of the hydrocarbon  
14 fluid. This is done by igniting the hydrocarbon fluid  
15 and flaring it from drilling rig, Floating Production  
16 Storage and Offloading vessels (FPSOs), Drillships,  
17 platforms and land rig burner booms. The flaring  
18 operation can cause temperatures to reach levels where  
19 the intense heat can compromise the integrity of the  
20 structure and rig safety equipment such as lifeboats,  
21 lifecrafts etc and create a hazardous working environment  
22 for personnel. One way of reducing the temperature  
23 around the flaring hydrocarbons is to form a water wall

1 around the flare, known as a rig cooling system and/or  
2 heat suppression and/or deluge system.

3  
4 Systems of this type provide an outer wall of water  
5 designed to surround the flare which mimics the flare  
6 profile and/or shields the flare. The outer wall of  
7 water can take the form of a solid flat or conical shield  
8 or curtain and a central source which has a secondary  
9 function of generating a very fine mist of water through  
10 the central outlet of the dual nozzle design. The fine  
11 mist of water is designed to remove energy from the  
12 flare, and the outer wall of water is designed to create  
13 a barrier which also removes energy and therefore  
14 temperature from the flare.

15  
16 In order to produce and shape a jet of water, it is  
17 necessary to connect a nozzle to a high-pressure water  
18 source and to engineer the nozzle such that an outer  
19 (typically cone-shaped) wall of water is formed in  
20 conjunction with a fine mist of water directed behind the  
21 flare.

22  
23 An example of this type of nozzle is provided in UK  
24 Patent No. GB2299281. This document discloses a nozzle  
25 attachable to a high-pressure water source in which a  
26 narrow opening is positioned between a deflecting surface  
27 which opposes the direction of flow of water, and a  
28 guiding surface angled towards the direction of flow of  
29 the water and which defines the shape of the outer wall  
30 of water that is produced by this nozzle. It has been  
31 found that the combined action of the deflecting surface  
32 and guiding surface disrupts the water flow and causes  
33 energy to be dissipated thus lowering the water pressure.

1 It is an object of the present invention to provide an  
2 improved nozzle.

3  
4 In accordance with a first aspect of the present  
5 invention, there is provided a nozzle for a hose or fixed  
6 pipework installation, the nozzle comprising:  
7 a body;  
8 a channel extending through the body of the nozzle; and  
9 a fluid deflector arranged at or near the downstream end  
10 of the channel, and wherein the fluid deflector  
11 determines the direction of flow of the fluid as it  
12 leaves the nozzle.

13  
14 Fluid flowing along the channel may impinge upon the  
15 fluid deflector and may travel along a surface of the  
16 deflector and out of the nozzle, the direction of flow of  
17 the fluid as it leaves the nozzle thereby determined by  
18 the deflector. By this arrangement, the fluid deflector  
19 may serve to direct the fluid whilst minimising energy  
20 loss when compared to prior nozzles of the type where the  
21 fluid is thrown backwards onto a second directing surface  
22 which directs the fluid out of the nozzle.

23  
24 The fluid deflector may be located in a fluid flow path  
25 extending through the nozzle along the channel.

26  
27 Preferably, the fluid deflector and the body of the  
28 nozzle together define a width of the channel at or near  
29 said downstream end. The fluid deflector may have a  
30 deflecting surface positioned relative to the end of the  
31 channel to define the width of the channel at or near the  
32 downstream end of the channel. Accordingly, at least  
33 part of the channel may be defined between the deflecting

1 surface and an outlet surface of the body. The deflecting  
2 surface and the body outlet surface may be substantially  
3 parallel.

4  
5 The deflector surface may be disposed at an obtuse angle  
6 relative to a main axis of the body and is preferably  
7 angled away from the body.

8  
9 More preferably, said channel width is variable. This  
10 may facilitate adjustment of a characteristic and/or  
11 parameter of the fluid exiting the nozzle, including  
12 velocity, fluid pressure, and/or the shape of a jet,  
13 stream or cloud of fluid exiting the nozzle. The channel  
14 width may be variable by adjusting a position of the  
15 fluid deflector relative to a remainder of the nozzle, in  
16 particular, relative to the nozzle body.

17  
18 The fluid deflector may be movably mounted relative to  
19 the body, to enable adjustment of a position of the  
20 deflector relative to the body. This may facilitate  
21 adjustment of the channel width.

22  
23 Preferably, the channel is provided with a gap or space  
24 suitable for accommodating a spacer to alter the position  
25 of the fluid deflector relative to the end of the  
26 channel, thereby varying the width of said channel.

27  
28 Alternatively, the deflector may be threadably coupled to  
29 the body, such that rotation of the deflector relative to  
30 the body may advance and / or retract the deflector  
31 relative to the body, thereby facilitating adjustment of  
32 the channel width. The nozzle may include a retaining  
33 member, such as a nut, clip or the like, for retaining

1 the deflector in a desired position relative to the body,  
2 to fix the channel width.

3

4 The nozzle may comprise a mechanism for adjusting the  
5 channel width, which may be a self-cleaning mechanism.

6 The mechanism may be hydraulic, electrical, electro-  
7 mechanical or mechanical, and may comprise an actuator  
8 for controlling a position of the deflector relative to  
9 the body, for adjustment of the channel width. The  
10 actuator may be adapted to be activated to move the  
11 deflector to increase the channel width, in order to  
12 facilitate flow of any debris such as particulate matter  
13 trapped in the nozzle and impeding fluid flow. The  
14 mechanism may comprise one or more sensors for detecting  
15 the presence of trapped debris. For example, the nozzle  
16 may include a pressure sensor or flowmeter for detecting  
17 an increase in pressure or reduction in fluid flow rate  
18 through the channel indicative of the presence of trapped  
19 debris impeding fluid flow.

20

21 Preferably, the fluid deflector comprises the deflecting  
22 surface and a central beam, shaft, boss or the like  
23 extending from the deflecting surface into the body of  
24 the nozzle, the central beam being attachable to the body  
25 of the nozzle.

26

27 Preferably, the nozzle is further provided with pressure  
28 sensing means.

29

30 Preferably, the channel extending through the body of the  
31 nozzle is an annular channel, but may be of any  
32 alternative, suitable shape.

33

1 Preferably, the nozzle further comprises a central  
2 channel extending through the body of the nozzle.

3  
4 Preferably, the central channel extends through the  
5 central beam of the deflector.

6  
7 The pressure sensing means may be located in the fluid  
8 deflector.

9  
10 Optionally, the pressure sensing means is located in the  
11 body of the nozzle.

12  
13 Preferably, the fluid deflector means further comprises  
14 filter coupling means for coupling a filter to the  
15 upstream end of the central channel.

16  
17 Preferably, the fluid deflector means further comprises  
18 nozzle-coupling means for coupling a nozzle to the  
19 downstream end of the central channel.

20  
21 More preferably, said nozzle coupling means is  
22 connectable to a nozzle for producing a fine spray of  
23 fluid.

24  
25 Preferably, the fluid deflector means is frusto-conical  
26 and is thus provided with a frusto-conical deflecting  
27 surface, angled away from the direction of fluid flow.  
28 Alternatively, the deflecting surface may be any other  
29 suitable shape and the deflector may be frusto-conical  
30 with an arcuate deflecting surface, in cross-section.

31

1 More preferably, the frusto-conical deflecting surface  
2 extends beyond the maximum width of the channel to direct  
3 the flow of fluid.

4  
5 Preferably, the nozzle is generally cylindrical in shape.

6  
7 Preferably, the nozzle is further provided with sensor  
8 means attached thereto.

9  
10 More preferably, the sensor means are attached to the  
11 fluid deflector means.

12  
13 More preferably, the sensor means are embedded in a front  
14 surface of the fluid deflector means.

15  
16 The sensor means can be temperature sensors, gas sensors,  
17 or other suitable sensors and may be hardwired through  
18 the nozzle to provide information on the temperature, gas  
19 composition pressure or other information.

20  
21 The nozzle may be constructed in a single piece.

22  
23 It will be understood that the nozzle may be suitable for  
24 use with a wide range of diameters of hoses or pipes of a  
25 pipework installation, and may therefore be dimensioned  
26 accordingly. However, embodiments of the invention may  
27 be particularly suited for use with hoses/pipes having  
28 diameters in the range of 1½" to 2" (approximately 38mm  
29 to 51mm), whilst other embodiments may be particularly  
30 suited for use with hoses/pipes having diameters of  
31 around 6" (approximately 152 mm) or more.

32



1 In accordance with a second aspect of the invention there  
2 is provided a kit of parts for a nozzle in accordance  
3 with the first aspect of the invention, the kit of parts  
4 comprising a body and a fluid deflector.

5

6 Preferably, the kit of parts further comprises a coupling  
7 means adapted to connect the deflector to the body.

8

9 Further features of the nozzle are defined in relation to  
10 the first aspect of the invention.

11

12 In accordance with a third aspect of the present  
13 invention, there is provided a nozzle comprising:

14 a body having a fluid outlet;

15 a fluid flow channel extending through the body, the  
16 channel in fluid communication with the body outlet; and

17 a fluid deflector located adjacent the body outlet and  
18 positioned such that fluid flowing along the channel

19 impinges on the deflector and is directed out of the

20 nozzle by the deflector, the direction of flow of the

21 fluid exiting the nozzle thereby determined by the

22 deflector.

23

24 Further features of the nozzle are defined in relation to  
25 the first aspect of the invention.

26

27 The present invention will now be described by way of  
28 example only, with reference to the accompanying  
29 drawings, in which:

30

31 Figure 1 is a longitudinal cross-sectional view of a  
32 nozzle in accordance with an embodiment of the present  
33 invention;



1 Figure 2 is a further, partial cross-sectional view of  
2 the nozzle of Figure 1;

3

4 Figure 3 is another sectional view of the nozzle of  
5 Figure 1 in which the fluid flow paths are shown;

6

7 Figure 4a shows the deflector of the present invention,  
8 Figure 4b shows a coupling ring as used in the present  
9 invention and Figure 4c shows a body of the nozzle of the  
10 present invention;

11

12 Figure 5 shows a second embodiment of the present  
13 invention in which sensors are embedded into the front  
14 surface of the deflector means;

15

16 Figure 6 is a longitudinal cross-sectional view of a  
17 nozzle in accordance with a third embodiment of the  
18 present invention;

19

20 Figure 7 is an exploded perspective view of the nozzle of  
21 Figure 6;

22

23 Figures 8 and 9 are end and sectional views,  
24 respectively, of a deflector forming part of the nozzle  
25 of Figure 6; and

26

27 Figures 10 and 11 are end and side views, respectively,  
28 of a body forming part of the nozzle of Figure 6.

29

30 In the embodiment of the present invention shown in  
31 Figure 1, the nozzle 1 is constructed from three separate  
32 components. These are the nozzle body 3, the coupling  
33 ring 5 and the deflector 7.

1 The deflector 7 is provided with a front surface 11, a  
2 deflecting surface 9 which is angled away from the  
3 direction of fluid flow and a central beam or projection  
4 10 which extends into the nozzle body 3 and provides a  
5 central channel 21.

6  
7 The central channel 21 has a filter coupler 33 to which a  
8 wire-mesh cone known as a Witch's Broom can be attached.  
9 The purpose of this filter is to prevent particulates  
10 from entering the central channel. A second coupler 13  
11 is attached to the downstream end of the central channel  
12 21. The second coupler 13 is used to attach a further  
13 nozzle for shaping the water flow. Suitably, the nozzle  
14 is designed to produce a fine spray or fog of water.

15  
16 Typically, the water used will be filtered upstream of  
17 the nozzle. Therefore, the size of particulates entering  
18 the nozzle will have a maximum determined by the upstream  
19 filter.

20  
21 The gap between the central beam 10 and the nozzle body 3  
22 defines an outer channel which is annular in shape.  
23 Support means in the form of fins 30 extend between the  
24 central beam 10 and the nozzle body 3 to secure the  
25 deflector 7 in place. Grub screws are used to further  
26 secure the deflector 9 in position. The nozzle may also  
27 be provided with a pressure indicator switch (not shown)  
28 located in the deflector surface or on the body of the  
29 nozzle. Fixed rings 25 are also included to position the  
30 deflector within the nozzle body 3.

31  
32 The box section 26 provides abutting surfaces at either  
33 end thereof, and further provides an adjustable gap 27

1 which can be reduced in size by the inclusion of further  
2 spacer rings (not shown). Typically, an additional  
3 spacer ring would be introduced at the downstream end of  
4 the box section 26 thereby moving the deflector in an  
5 upstream direction and therefore reducing the size of the  
6 adjustable gap 27. This also reduces the width of the  
7 end of the channel as defined by the distance between the  
8 deflector surface 9 and the chamfered surface 15.

9  
10 It will be noted that the deflector 7 is generally  
11 frusto-conical or cone-shaped. The chamfered surface 15  
12 provides a way of smoothing the flow of fluid at the  
13 downstream end of channel 23, and as a consequence  
14 creates a more laminar fluid flow.

15  
16 Providing an adjustable gap between the deflector surface  
17 9 and the chamfered surface 15 provides water flow having  
18 different profiles. For example, where the gap between  
19 the chamfered surface 15 and the deflector surface 9 is  
20 small, the flow of water from the nozzle will be  
21 disrupted and this will create a non-uniform flow to  
22 produce a more diffuse wall of water. Where this  
23 distance is larger the flow will be more laminar and the  
24 wall of water will be less diffuse.

25  
26 The chamfered surface 15 forms part of a coupling ring  
27 which is attached to the nozzle body 3. The upstream end  
28 of the nozzle body 3 is provided with a nozzle coupler  
29 31, for coupling the nozzle 1 to a hose or pipework. The  
30 nozzle 1 is dimensioned for coupling to a 6"  
31 (approximately 152mm) diameter hose or pipe, although it  
32 will be understood that the nozzle 1 may be provided for  
33 a hose or pipe of any suitable diameter. In this example,

1 the coupler 31 is a screw thread. As the water has been  
2 filtered upstream, the gap between surfaces 9 and 15 will  
3 provide a flow path that is not restricted by the  
4 presence of large particulates. Accordingly, this will  
5 not block or inhibit the performance of the nozzle.  
6 Figure 2 provides a further, partial cross-sectional view  
7 of the present invention and shows the outer surface of  
8 the central beam 10 and the fins 30. The features of  
9 this drawing are identical to the features shown in  
10 Figure 1.

11  
12 Figure 3 shows the water flow path through the nozzle.

13  
14 The water flows through the main channel 19 at the  
15 upstream end of the nozzle in direction A. The flow is  
16 then split into two portions which flow through the  
17 central channel 21 in direction C and through the outer  
18 channel 23 in direction B. A filter (not shown) is  
19 attached to the filter coupler 33. This prevents  
20 particulates from entering the central channel and  
21 directs them out through the outer annular channel 23.  
22 This is desirable because the purpose of the central  
23 channel is to provide a fine mist of water by using a  
24 fine nozzle (not shown). The use of a filter prevents  
25 particulates from entering the fine nozzle, and thereby  
26 blocking it.

27  
28 As the water flows through the outer channel 23 in  
29 direction B, the water is deflected from surface 9  
30 outwards in a pre-determined direction. This direction  
31 is determined by the angle of the deflection surface 9  
32 with respect to the direction of bulk flow through the  
33 channel 23. In this example, the surface 9 is at an

1 angle of approximately  $105^\circ$  with respect to the central  
2 beam. Clearly, therefore, the deflector surface 9 is  
3 angled away from the direction of flow B.

4  
5 Advantageously, it has been found that the use of a  
6 deflector surface in this configuration means that the  
7 general bulk flow B loses energy only when it is  
8 deflected from the surface 9. Therefore, it is possible  
9 to produce a more efficient nozzle that requires a lower  
10 water pressure to produce a wall of water that extends a  
11 predetermined distance from the nozzle than would be  
12 possible with the prior art nozzles. In addition, it is  
13 possible to produce walls of water that extend further  
14 with the same pressure than in the prior art.

15  
16 It should be noted that in the prior art the exiting  
17 water impinges on a first surface, and is thrown  
18 backwards onto a second directing surface for directing  
19 the water out from the nozzle. This causes the water to  
20 lose energy and therefore causes a reduction in overall  
21 pressure.

22  
23 In addition, the present invention may also be provided  
24 with means for altering the width of the gap between the  
25 chamfered surface 15 and the deflector surface 9. In  
26 order to alter this distance, a spacer ring (not shown)  
27 is introduced into the nozzle body so as to reduce the  
28 width of gap 27. A number of rings of different width  
29 can be used to produce different gap sizes.

30  
31 Figures 4a, 4b and 4c show the components from which an  
32 embodiment of the present invention can be made. Figure  
33 4a shows the deflector means 7, Figure 4b shows the

1 coupling ring 5 and Figure 4c shows the nozzle body 3.  
2 It is convenient for the nozzle of the present invention  
3 to be constructed in three parts in this manner as it  
4 allows easy cleaning and maintenance of the nozzle.

5  
6 Figure 5 shows a second embodiment of the present  
7 invention in which sensors 112 are embedded into the  
8 front surface 111 of a nozzle 101. The sensors can be  
9 hard-wired and/or wirelessly and/or acoustically  
10 connected through the central channel 121 to a position  
11 upstream where data from the sensors can be analysed.  
12 The sensors can be temperature sensor, gas composition  
13 sensors or any other desired sensor.

14  
15 In the examples of Figures 1-4 and 5, the fins 30 may be  
16 shaped to affect the flow of water through the outer  
17 channel 23.

18  
19 Turning now to Figure 6, there is shown a longitudinal  
20 cross-sectional view of a nozzle in accordance with a  
21 third embodiment of the present invention, the nozzle  
22 indicated generally by reference numeral 201. Like  
23 components of the nozzle 201 with the nozzle 1 of figures  
24 1-4c share the same reference numerals incremented by  
25 200.

26  
27 The nozzle 201 is dimensioned for coupling to a hose or  
28 pipe of a diameter in the range of 1.5"-2" (approximately  
29 38mm-51mm), although it will again be understood that the  
30 nozzle 201 may be provided on a hose or pipe of any  
31 suitable diameter, and thus dimensioned accordingly.

32



1 The nozzle 201 is similar to the nozzle 1 of Figures 1-  
2 4c, except that the nozzle 201 comprises two main  
3 components, a nozzle body 203 and a fluid deflector 207  
4 which is coupled to the nozzle body 203. As will be  
5 described below, the deflector 207 is secured to the  
6 nozzle body 203 by a retaining member in the form of a  
7 nut 35.

8  
9 The nozzle 201 is shown in more detail in the exploded  
10 perspective view of Figure 7. Also, the deflector 207 is  
11 shown separately from the body 203 in the end and  
12 sectional views of Figures 8 and 9, and the body 203 is  
13 shown with the deflector 207 removed in the end and  
14 sectional views of Figures 10 and 11.

15  
16 Only the main differences between the nozzle 203 and the  
17 nozzle 1 of figures 1-4c will be described herein in  
18 detail.

19  
20 The body 203 includes a central beam or a shaft 210 which  
21 is located by fins 230 that are formed integrally with  
22 the body 203. The beam 210 is threaded at 37 and the  
23 deflector 207 includes a hub 39 which is internally  
24 threaded for engaging the beam threads 37. In this  
25 fashion, the deflector 207 may be coupled to the body 203  
26 and the gap between the deflector surface 9 and a  
27 chamfered surface 215 of the body 203 may be adjusted by  
28 rotating the deflector 207, causing the deflector to  
29 advance or retract along the beam 210 relative to a main  
30 part of the body 203. The deflector 207 is locked in  
31 position by a retaining member in the form of a threaded  
32 nut 35 which engages the beam threads 37 and abuts the  
33 deflector 207. If required, however, spacer rings (not



1 shown) may be provided between a shoulder 41 of the body  
2 203 and the deflector 207.

3  
4 In a variation, the deflector 207 may include a smooth  
5 hub 39 and may be clamped in position between the  
6 shoulder 41 of the body 203 and the nut 35. Spacer rings  
7 may be located between the shoulder 41 and the deflector  
8 207 to increase the spacing between the deflector surface  
9 209 and the chamfered surface 215 on the body 203.

10  
11 In a similar fashion to the nozzle 1, the nozzle 201  
12 defines a central flow channel 221 whilst the body 203  
13 defines an outer flow channel 223. In use, fluid flow is  
14 split between the inner and outer channels 221, 223 and a  
15 further nozzle may be provided coupled to a coupler 213  
16 on the beam 210.

17  
18 The nozzle 201 additionally includes a self-cleaning  
19 mechanism (not shown) for adjusting the channel width at  
20 the downstream end, that is the space or gap between the  
21 deflector surface 209 and the chamfered surface 215 of  
22 the body 203. The mechanism is typically hydraulic,  
23 electrical, electro-mechanical or mechanical and includes  
24 an actuator for controlling adjustment of the channel  
25 width. For example, the mechanism may comprise a motor  
26 for adjusting a position of the deflector 207 relative to  
27 the body 203. This may be achieved by rotating the  
28 deflector 207 to advance or retract the deflector along  
29 the beam 210 either by direct rotation of the deflector  
30 207 relative to the beam 210, or the beam 210 may be  
31 provided as a separate component coupled to or integral  
32 with the deflector 207, and may be rotatable relative to  
33 the body 203.

1 The self-cleaning mechanism may be actuated to increase  
2 the channel width between the deflector surface 209 and  
3 the chamfered surface 215 of the body 203 in response to  
4 the detection of the presence of trapped debris, such as  
5 particulate matter in the nozzle 203. Such debris may  
6 cause a reduction in the flow rate of fluid through the  
7 nozzle and/or an increase in fluid pressure, which may be  
8 detected by appropriate sensors. On detection of such a  
9 situation, the self-cleaning mechanism may automatically  
10 activate the actuator to adjust the position of the  
11 deflector 207, increasing the channel width and allowing  
12 clearance of the blockage.

13  
14 The embodiments of the present invention described herein  
15 show a nozzle designed for manufacture using a lathe  
16 (Figures 1 to 5) and by casting (Figures 6 to 11).  
17 Details of the component design may change where other  
18 manufacturing techniques are used to make the nozzle.  
19 Examples of alternative manufacturing techniques are lost  
20 wax processing or a combination of techniques.

21  
22 In addition, the nozzle may be made in modular form or as  
23 a single component.

24  
25 It is also envisaged that the present invention could be  
26 used for escape route protection, well control and where  
27 blowouts occur.

28  
29 Improvements and modifications may be incorporated herein  
30 without deviating from the scope of the invention.